Land Resources and Uses

Nevadans past and present have overcome the hardships that arid valley and steep mountain environments can impose on human enterprise. To the casual observer, a vast majority of the state may appear vacant, wide-open, and wild. A closer look reveals that the land and all it bears has long been put to productive and recreational uses. Land here is grazed by livestock; irrigated and farmed; logged for wood products and fuel; mined for gold, silver, copper, and other metals; drilled for oil and geothermal energy; developed for rural and urban communities, industry, and transportation; and, enjoyed by a wide variety of outdoor recreationists. However, the dry climate and rugged landscape leave little margin for excessive use or neglectful management of the soil, water, vegetation, and wildlife. Decisions about resource utilization, especially water, greatly impact ecosystem health and the socioeconomic well being of communities. Sustaining resources harvested and extracted for food, fiber, energy, and minerals depends upon careful and vigilant stewardship of the environment by all individuals and institutions.

People often think of the landscapes around them in terms of the dominant land use or vegetation cover. Common terms include rangeland, forestland, farm and ranch land, mineral resource (mining) land, military land, urban and suburban developed land, and wilderness. Part 4 uses these terms to organize information about the land and resource use in Nevada. Land cover and land use types were mapped by Utah State University in collaboration with the BLM and USFS using circa 1990 satellite images (Gap Analysis Program, circa. 1995). Not surprisingly, the analysis shows that about 81 percent, or 57.5 million acres, of Nevada's landscapes can be described as rangeland (Table 4-1). Forestland, including pygmy conifer (pinyon and juniper) woodlands, covers about 8.5 million acres, or 12 percent of the state. Wetlands and riparian zones cover about 0.7 percent of the state's land area. The estimate of 0.5 million acres for this land cover type probably underreports the actual amount. Similarly, agricultural land estimated at 1.4 million acres, may be understated, since irrigated fields are rotated and only a portion of farmland receives water each year.

Table 4-1. Estimated Area of General Land Cover Types In Nevada

Vegetation Group	Area (Acres)	Gap Land Use/Cover Types
Rangeland	57,506,465	All listed below
Herbs and grass	1,873,843	Grassland, Dry Meadow
Sagebrush	30,531,351	Sagebrush, Sagebrush/Perennial Grass
Lowland Shrubs	20,366,039	Salt Desert Scrub, Greasewood, Blackbrush, Hopsage, Mojave Mixed Scrub
Creosote	3,563,553	Creosote/Bursage
Mountain Shrubs	1,171,679	Bitterbrush, Mountain Sagebrush, Sierra Mountain Shrub
Forest	8,505,556	All listed below
Hardwoods/deciduous	283,865	Ash, Aspen
Conifers	575,850	Englemann Spruce, Great Basin Subalpine Pine, Mojave Bristlecone, Pondersoa Pine, Sierra Lodgepole, Sierra Red Fir, Sierra Whitebark Pine, Sierra White Fir, Sierra Yellow Pine, Subalpine Fir, White Fir
Mountain mahogany	535,498	Mountain mahogany
Pinyon/Juniper Woodland	7,110,343	Juniper, Pinyon, Pinyon/Juniper
Riparian and Wetland	476,744	Wet Meadow, Lowland Riparian, Mountain Riparian, Wetland, Open Water
Agriculture	1,429,990	Row Crops, Irrigated Pasture and Hay Fields, Dry Farm Crops

Source: Original land use/cover types data from Gap Analysis Program by Utah State University.
Notes: Gap Land use and land cover types are named for the dominant plant species. Typically, other vegetation types are intermixed, but constitute less than 30 percent of the land cover. Cover types not included are alpine, barren, playa, sand dunes, snow, and urban.

Rangeland

Rangeland covers an immense portion of the state and provides a variety of ecological and economic benefits. Benefits of healthy rangeland include watersheds for rural and urban uses, livestock products, wildlife habitat, and land for urban development. These lands also provide aesthetic value, open space, and outdoor recreation. Rangeland is often used to refer to a group of vegetation zones composed primarily of shrubs, grasses, and forbs that are suitable for grazing and browsing animals, most notably domestic livestock, large herbivores (e.g., mule deer, elk), and wild horses.

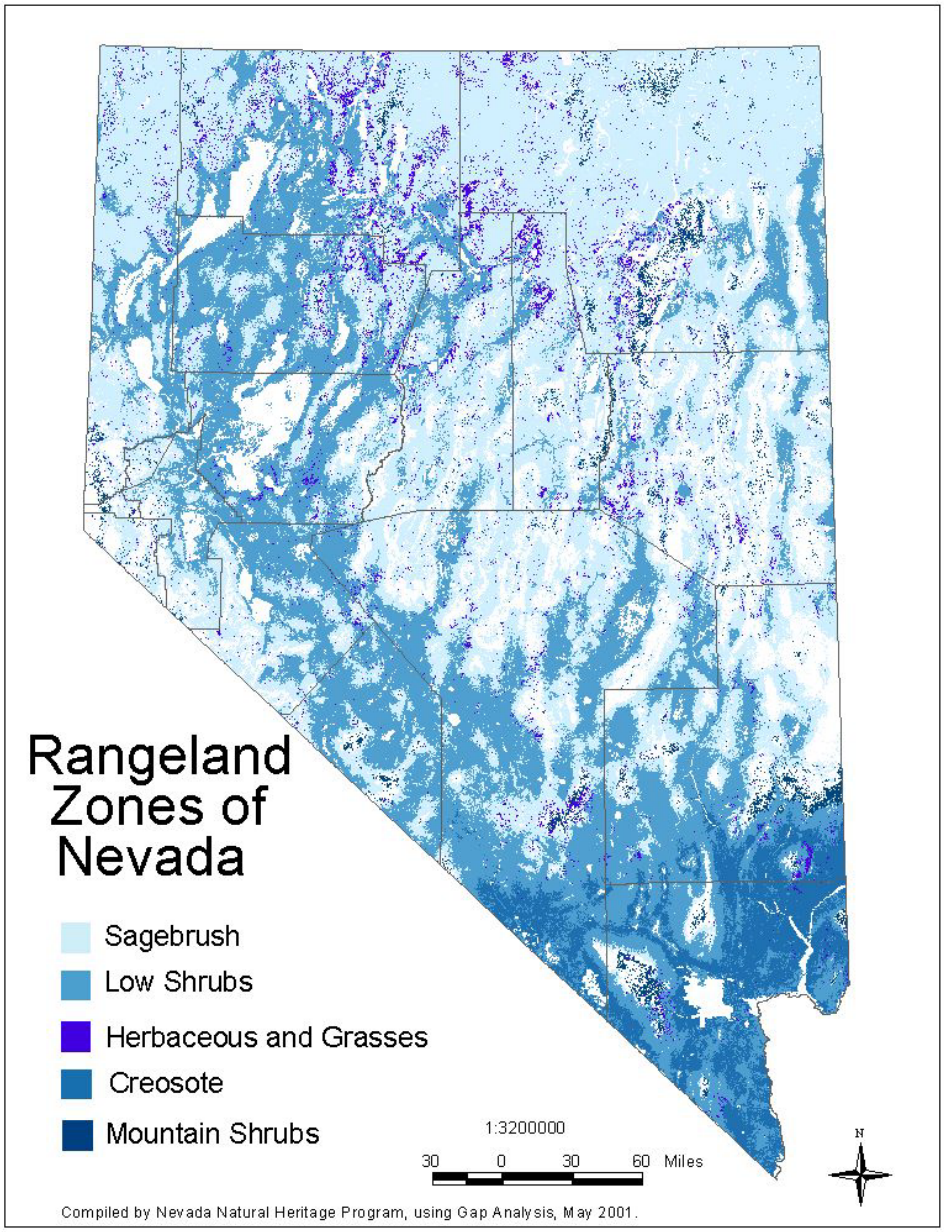
About 57 million acres (81 percent of the state) may be classified as rangeland. The vegetation zones include: sagebrush, mountain sagebrush, and sagebrush/perennial grass (sagebrush zone); salt desert scrub, greasewood, blackbrush, and Mojave mixed scrub (lowland shrub zone); dry meadows and perennial and annual grasslands (herbaceous and grasses zone); creosote/bursage (creosote zone); and, bitterbrush, mountain shrub, and Sierra mountain shrub (mountain shrubs) (Figure 4-1). Streams, springs, and patches of wetlands and riparian zones, woodlands, and forested areas are interspersed throughout rangelands, adding to the diversity of wildlife and variety of human uses. Rangeland uses include livestock grazing, ranching and farming, outdoor recreation, wildlife and fish habitat, wild horse and burro habitat, mining, and urban and rural community development.

Herbaceous and grass type covers about 1.9 million acres dispersed throughout the state. The dry meadow type is most prevalent in the foothills and mountains of northern Great Basin, Columbia Plateau, and the Sierra Nevada ecoregions. The grassland type is a northern Nevada feature, consisting of cheatgrass monocultures or grasslands, introduced perennial grasslands, or patches of native grasslands. Well-represented native grass species include wheatgrasses, bluegrasses, needlegrasses, basin wildrye, blue gramma, squirreltail, and Indian ricegrass.

The lowland shrub zone includes salt desert scrub, greasewood, blackbrush, and Mojave mixed scrub. Lowland shrubs cover 20.4 million acres on valleys and slopes below 5,000 feet. The largest expanses occur in the southern, central and northwestern part of the state, including the Mojave and Amargosa deserts northward to the Black Rock and Smoke Creek desert basins. This zone receives the least precipitation and experiences the warmest temperatures. Moist, saline soil conditions exist in some valley bottoms, generally identifiable by the presence of greasewood and salt grass, often up to the edge of a playa. In the salt desert scrub zone, dominant shrubs include shadscale, greasewood, winterfat, budsage, horsebrush, fourwing saltbush, and mormon tea. Saltgrass, Indian rice grass and cheatgrass area associated species. The salt desert scrub zone provides winter forage and cover for many forms of wildlife and livestock. Mojave desert mixed scrubland occupies lower slopes, washes or upland areas. The zone is characterized by creosote with bursage, desert thorn, hopsage, blackbrush, yucca, and cacti. The creosote-bursage zone is widely distributed in the Mojave Desert below 4,000 feet on valley floors and mildly sloping lowlands. Blackbrush, Mormon tea, indigo bush, honey mesquite, and brittlebush are associated shrubs. Yucca, prickly pear, and Joshua tree are also present (Cronquist, 1972).

A much smaller, but more productive rangeland component is the mountain shrubs zone. Mountain shrubs occupy almost 1.2 million acres, generally at elevations above 6,500 feet. Unlike the lower sagebrush and salt desert scrub zones, this vegetation zone has eluded major vegetation conversions and remains in relatively good condition. Serviceberry, snowberry, currant, bitterbrush, are present throughout. Unique shrub species in the Sierra Nevada ecoregion include varieties of manzanita, tobaccobrush and other species in the *Ceanothus* genera, and chinquapin. Patches of mountain mahogany, aspen, and conifers are common. The moister and cooler conditions at upper elevations help to sustain the vigor of native plants, giving them an edge over aggressive annual grasses and weeds. More moderate environmental conditions also dampen the risk of large and severe wildfires. Pinyon pine and juniper stands are expanding in central and eastern Nevada and in some locations crowding out the shrub and grass understory. Overcrowded woodlands reduce forage, creating competition among big game population and livestock herds. Mechanical thinning and prescribed fire are among the alternative measures being used to manage pygmy conifers.

Figure 4-1. Approximate Distribution of Rangeland Vegetation In Nevada



Sagebrush dominates the state, with subtly different shrub communities spanning 30.5 million acres. One or more of the twelve species and subspecies of sagebrush dominates over half of the state's rangeland. The sagebrush/perennial grass (also known as sagebrush steppe) and Great Basin sagebrush ecosystems are the two dominant types. Mountain sagebrush is prevalent above 6,500 feet in central and northern Nevada. Sagebrush steppe is more common in the Columbia Plateau ecoregion and mid-elevations in the central mountains in semi-arid microclimates. Associated shrubs may include bitterbrush, rabbitbrush, currant, gooseberry or cliffrose. Grasses make up a significant portion of the steppe plant mix. The Great Basin sagebrush zone typically occurs above 4,500 feet and native grass species make a small percentage of the understory or do not occur at all. An exception is areas invaded

by cheatgrass. Stands of juniper, pinyon pine, and possibly Jeffrey or ponderosa pine are intermixed. This lower elevation sagebrush ecosystem is the most widespread and abundant cover type in Nevada.

Scientists uncovering the natural prehistory of Nevada's ecoregions have found that rangeland plant communities were adapted to light to moderate grazing by comparatively small populations of large and small herbivores (e.g., pronghorn antelope, mule deer, elk, bighorn sheep, jack and cottontail rabbits) (Grayson, 1993). Other major influences on vegetation include human harvesting practices and frequency of natural and human-set fires. Given the low population densities and seasonal movements, native populations food gathering and use of fire likely affected only a small fraction of the landscape (Griffen, 2002). Since settlement, domestic livestock grazing has been the primary use of rangelands. The BLM and USFS combined manage about 85 percent of the rangeland areas in the state. Cattle and sheep production on public rangeland is managed within grazing allotments by permittees and agency resource scientists. In 1999, the BLM held 700 permits for livestock grazing on 45 million acres of the 48 million acres administered by the agency (U.S. Bureau of Land Management, 2000). On Humboldt-Toiyabe National Forest (HTNF) land, the USFS administered 298 grazing allotments covering 4.7 million acres of the total 5.8 million acres in the national forest (Humboldt-Toiyabe National Forest, 2001). The allotment and acreage totals include HTNF land in Nevada and California, of which 92 percent lies in Nevada.

The arid climate, low annual forage production, and the small amount of private holdings with sufficient area to make livestock operations economically viable requires the use of forage resources available on surrounding public lands. Almost all of the cattle and sheep raised in Nevada are produced on ranches that make some use of public rangelands. The non-federal component of rangeland used for livestock grazing livestock is significant (Table 4-2). The total amount of nonfederal rangeland used for grazing has changed little since the early 1980's, but grazing on pasture and forestland has decreased (U.S. Natural Resources Conservation Service, 2000). Private ranch land contains valuable water resources and riparian habitat, and therefore is important to maintaining healthy watersheds. Livestock operations either own or lease private land and get a BLM and/or USFS permit for the federal public land. Compared with other states, Nevada ranches, supplemented with public grazing land, are large but capable of continuously supporting relatively small numbers of livestock.

Table 4-2. Changes in Nonfederal Grazing Land in Nevada, 1982 - 1997

Year	Pasture Land	Rangeland	Forest Land	Total Non-federal Grazing Land
1982	312,600	8,246,200	366,000	8,924,800
1987	313,000	8,280,600	374,400	8,968,000
1992	310,300	8,258,700	374,900	8,942,900
1997	279,000	8,372,400	305,000	8,956,400

Source: Modified from 1997 National Resources Inventory, Revised December 2000. Website: http://www.nrcs.usda.gov/technical/land/grazing.html

The BLM manages and monitors forage and ecological conditions. Forage production and utilization (i.e., proportion of plants removed) traditionally has been the focus of monitoring. In recent years, ecological site condition monitoring is being performed more often. Ecological site condition monitoring is based on a comparison of existing soil, vegetation, wildlife, and physical site conditions to more natural conditions. The data from monitoring are used to evaluate post- or pre-grazing carrying capacity, select grazing management practices, and set priorities for special range improvement activities on public lands. To be consistent with multiple use principles, the BLM allocates available forage to each class of grazing animal, including domestic cattle and sheep, mule deer, elk, bighorn sheep, pronghorn antelope, and wild horses and burros. The BLM in 1999 used the combined results from ecological site and forage condition monitoring to characterize rangeland conditions. Of the 45 million acres covered under grazing allotments, five percent was rated in excellent condition and 12 percent poor (Figure 4-2). About 21 million allotment acres were rated as fair to poor (47 percent) and 13.6 million acres as good to excellent (13.6 percent). Grazing, fires, and nonnative plants are factors in the proportionately large amount of grazed rangeland in fair to poor condition (U.S. Bureau of Land Management, 2000)

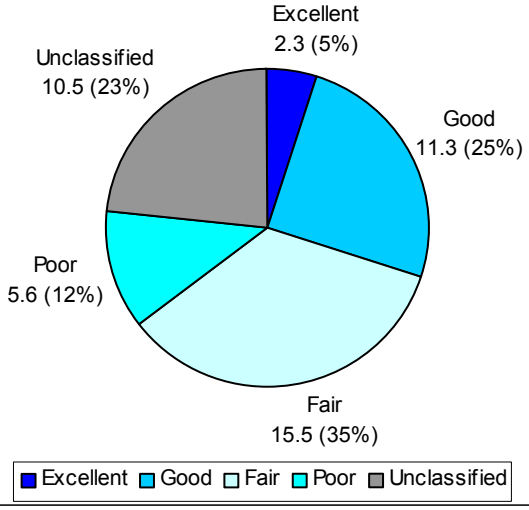


Figure 4-2. Summary of Ecological Status and Forage Conditions on BLM Grazing Land (million acres)

Source: Nevada Bureau of Land Management, 2000.

Historically, cattle and sheep repeatedly grazed sagebrush, salt desert shrub, mountain shrub, and riparian zones, exhausting the regenerative capacity of native grass and shrub species. Though improvements in grazing management practices have been made throughout the state, harsh environmental conditions have slowed recovery of the natural vegetation. Ultimately, the extensive removal of perennial grasses substantially changed the sagebrush zone. Thickening shrub canopies and cheat grass understory have filled the voids. The flammability of cheat grass and closure of the shrub canopy has created conditions favorable to wildfire (Young, 1985).

During the 1999 and 2000 fire seasons, wildfires consumed more than one million acres in the sagebrush zone. The intensity of some fires completely destroyed much of the vegetation within burned areas and seeds stored in the upper soil layer. Without native seed sources nearby, burned sagebrush habitats are not capable of natural regeneration, and therefore more susceptible to invasion by non-native plants. The spread of noxious weeds, some of which have been present in small numbers for decades, appears to have accelerated in recent years. In some areas, the numbers of livestock may still exceed the carrying capacity of rangeland plant communities. Less vegetative cover and fewer deep rooted plants increases runoff and accelerates erosion, contributing to the high sediment and nutrient loads in water quality impaired reaches of major rivers.

A related concern is the effects of wildfire on the distribution and abundance of vegetation consumed by game animals, livestock, and wild horses. Competition among the large grazing animals is likely to further degrade sagebrush ecosystems unless animal numbers are managed in proportion to acres of habitat burned. Wildfire and resulting overgrazing can impair living conditions for sensitive species as well. Special status wildlife species dependent on sagebrush habitats include the Sage Grouse, Burrowing Owl, Mountain Quail, Brewer's Sparrow, pygmy rabbit, sagebrush vole, and the sagebrush lizard.

The deterioration and conversion of millions of acres of sagebrush, riparian and other rangeland communities is a serious ecological event. The intensity of concern is evident in the number of agencies, scientists, and interest groups working on special collaborative studies and planning efforts involving restoration of sagebrush ecosystems. High profile cooperative efforts mentioned previously that focus on the sagebrush vegetation zone at-large include the Great Basin Restoration Initiative, sponsored by the BLM, and state sponsored initiatives for sage grouse conservation, fire management, and invasive weed control.

Rangeland areas are undergoing more permanent changes too. Rangeland made up 78 percent of the total land in Nevada developed for residential, commercial, industrial, utility, and transportation uses from 1992 to 1997. Though the amount of land converted is less than 0.5 percent of the total rangeland area, other associated activities extend the influence of development beyond building footprints. Solid waste

disposal; illegal dumping; hiking, biking, and motorized recreation trails; and, road and utility corridor construction are examples. Mining also constitutes a substantial and expanding use of Nevada's rangeland. However, information on the amount of rangeland converted for historic and contemporary mineral development was not available.

The use and management of public rangeland resources is becoming more challenging with the growing number and diversity of public land users. On today's federal public rangeland menu are livestock grazing, dozens of outdoor recreation pursuits, wildlife habitat, riparian management, endangered species management, mining, hunting, cultural resource protection, wilderness, wild horse and burro habitat, energy development, and various special uses. Administration of large land areas is especially challenging as national offices of federal agencies make frequent changes in policies and enforcement of regulations. Meeting the multiple use mandate has created divisiveness in Nevada where competition among incompatible land use activities is high. Public pressure from interests on all sides has required the agencies to open up their land use and resource planning processes, sometimes slowing down the decision making process. Because such a vast amount and diversity of Nevada's natural resources are found on the rangeland, special care is warranted in land management decisions. Investment in restoration of deteriorated conditions is vital to the future of agriculture, wildlife, and the quality of outdoor recreation experiences in Nevada.

Forestland

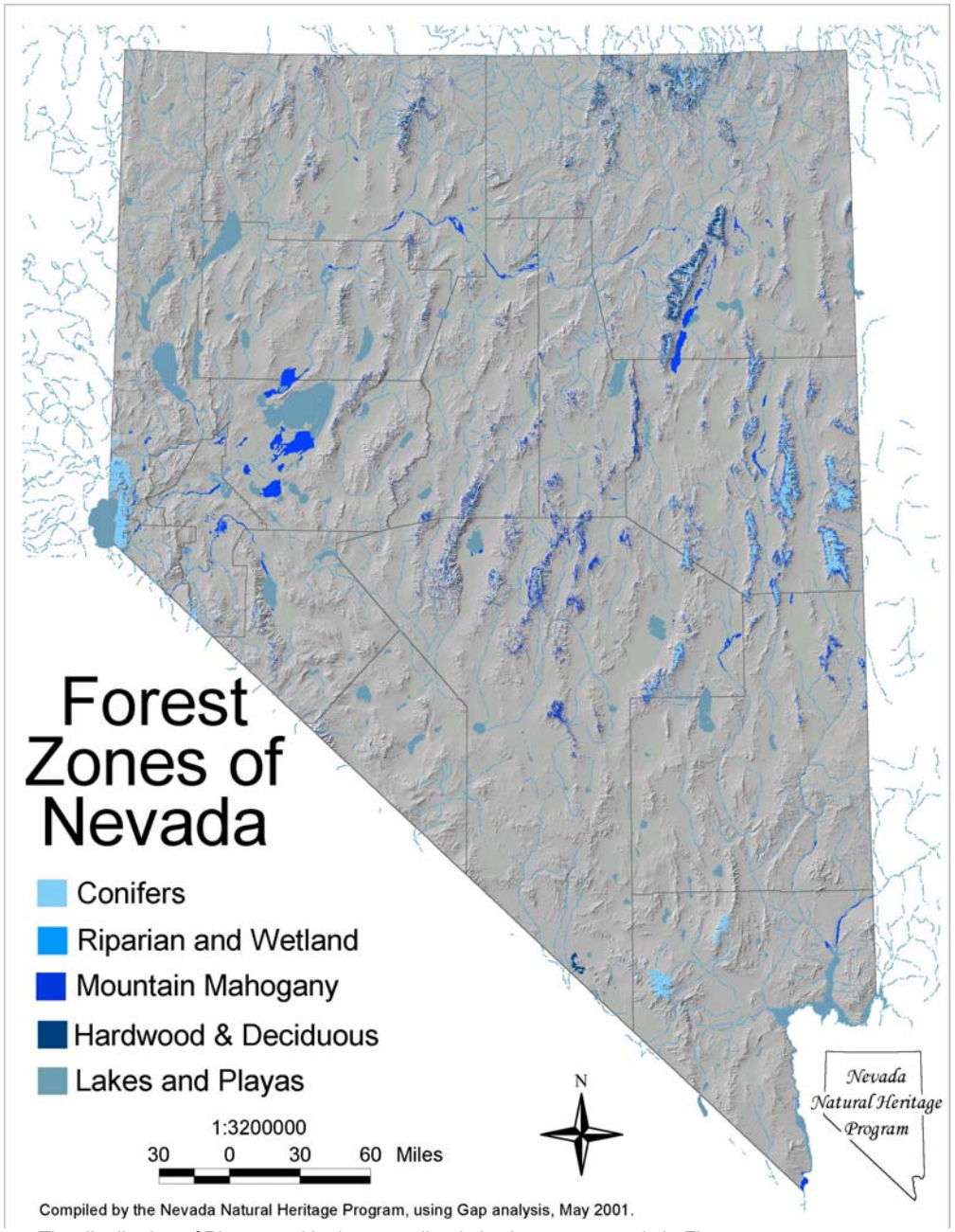
Forestland types cover approximately 8.5 million acres (12 precent) in Nevada. Forests can be divided into two major types, timberland and woodland. Timberland is comprised of conifer tree species (575,850 acres) formerly used for saw-log wood products such as ponderosa, Jeffrey, western white, sugar, and lodgepole pine, white and red fir, and incense cedar. Figure 4-3 shows the approximate distribution of timberland forests. Heavily logged in the past, conifer forests in many mountain ranges have rebounded and form fairly continuous forested areas, especially in the Sierra Nevada and Carson ranges and the Spring Mountains of western and southern Nevada. Large conifer forest patches also occupy higher mountains of central and eastern Nevada in varying mixtures of whitebark, bristlecone, ponderosa and limber pine as well as subalpine fir and Engelmann spruce. Aspen and cottonwood are the most common deciduous trees and are widespread along riparian areas, sometimes forming large groves around streams, springs and seeps.

Hardwoods and deciduous woodlands occupy about 283,865 acres. Mountain mahogany (535,500 acres) typically occurs above the Pinyon-Juniper woodlands, mostly in the mountains of northern, central, and eastern Nevada. Pinyon-Juniper woodlands are the most common forest type in the state.

More than 92 percent of the forestland occurs on Nevada's public lands and are managed primarily by the USFS and the BLM. Since 1969, the USFS has acquired 71,000 acres of forestland in the Carson Range of western Nevada. Conversion of private forestland to public land has decreased private commercial timber harvests and revenue. Approximately 750,000 acres of forestland is in private ownership with concentrations in the Carson Range of western Nevada, the Ruby Mountains, the Schell Creek Mountains of eastern Nevada, and portions of the Spring Mountains in southern Nevada (Nevada Division of Forestry, 2000). A large majority of non-industrial private forestlands are not adequately managed for their forest resource values.

Few forested areas are representative of the range, density, and mix of species that existed prior to settlement. Forests and their ecological conditions have been altered by commercial and domestic use, as well as to accommodate agricultural, urban, mining, and railroad development. As a result, a majority of the timberland resources during the 19th Century were depleted. Second growth stands found today occupy higher elevation and steep terrain that is difficult to log or treat for fuel loading. The margins of some conifer forestlands that were clear-cut have not regenerated, likely the result of erosion of barren soils and drier, warmer microclimates across exposed slopes. Overcrowded conditions are widespread on conifer and pygmy conifer forestlands, the result of aggressive fire suppression tactics and reduced harvests. Overstocked forests produce less streamflow, reduce groundwater recharge, and may

Figure 4-3. Approximate Distribution of Forestland in Nevada



Note: The distribution of Pinyon and juniper woodlands is shown separately in Figure 4-4.

contribute to higher flood frequency and peak flow. The Nevada Bird Conservation Plan prepared by the Nevada Working Group of Partners In Flight, prioritizes 21 bird species in conifer, pinyon and juniper, and aspen habitats for special conservation needs. The predominantly forested Carson Range on the edge of the Sierra Nevada ecoregion is designated a high priority conservation site by the Nevada Natural Heritage Program. Several sensitive plant and animal species inhabit the area.

The forests in the Sierra Nevada ecoregion of western Nevada generally receive substantially more attention than other forested areas because of the association with the large continuous Sierran forests, higher timber reproduction potential, and the proximity of rapidly growing urban areas. In the past 20

years, remaining foothill conifer forests along the eastern Sierra Front in western Nevada (including the Lake Tahoe Basin and the Carson Range) have become popular sites for residential development. Approximately 3,500 acres of timberland have been converted along the Sierra Front, resulting in the loss of commercial harvesting, recreational opportunities, and restricted public access to public lands (Nevada Division of Forestry, 2001). Developments in forested areas also threaten critical watershed values, diminish scenic beauty, and increase the risk that lives and personal property will be lost to wildfires. A majority of the timberland areas are overstocked, comprised of even-age class, and standing dead trees. Pine and fir beetles and mistletoe infestations are common in the Sierran forests. The potential for management of park-like, old growth forest appears to be limited to small, high elevation patches.

Timber harvests ten years ago were permitted primarily for private commercial timberlands. Timber harvest production has declined from about 2.3 million board feet per year to 150,000 (Nevada Division of Forestry, 2000). Most tree harvesting permits now are for fire fuels management (e.g., thinning dense areas) to meet subdivision development requirements or for forest ecosystem health. The last timber harvest permit issued in the Sierra Nevada on private commercial timberland was in 1998. In the Carson Range, fuelwood production has declined from 3,162 cords in 1990 to 550 cords in 2000. The mills closer to northwestern Nevada in Truckee, Loyalton, and Pioneer, California, have closed. Some potential commercial forest product uses have been identified, but markets have not emerged in the western Nevada region.

Forest Resources Status

Insects, disease, competing vegetation, climate, fire, and humans are the main factors that determine the health of forests. Overcrowded conditions are a widespread problem on some Nevada forestlands.

A majority of the forested lands in Nevada are administered by the USFS. Federal agency reports were relied upon to compile forest health information. Other sources of information include state agency reports, scientific publications, and personal communication with experts. Detailed information is lacking on the condition of much of Nevada's forested lands. However, during Summer 2000, the National Forest Health Monitoring (FHM) program was begun by the USFS in Nevada. The FHM will provide ongoing information on forest conditions in the state. The first report became available in Spring 2002 (U.S. Forest Service, 2002)

Subalpine Timberline Forests and Woodlands

This high elevation ecosystem occurs in remote locations in the island mountain ranges in Nevada. Five needle pines (whitebark, limber, and bristlecone pines) are common species. The typical forest structure is open with older aged trees. Fires are infrequent in this forest type due to its open nature, low fuel accumulation, and cooler conditions. Fire return intervals are likely over 100 years. Consequently fire suppression has likely had limited impact on this type. Aerial surveys in 1999 revealed a fair amount of mortality caused by mountain pine beetle in the Toquima, Toiyabe, Shoshone, Jarbidge, Ruby and East Humboldt Ranges. This is the first time these ranges have been surveyed in a number of years, so it is uncertain whether or not this beetle activity is unusual. Five needle pines are susceptible to the exotic disease white pine blister rust. This pathogen has not appeared yet in the interior of the state, but is located on the western border in all five-needle pine species.

Engelmann Spruce - Subalpine Fir

This forest type is found primarily in the Jarbidge range and Pilot, Snake and Schell Creek ranges. Subalpine fir mortality is occurring at high levels in the Jarbidge Mountains due to a complex of insects and disease pathogens. Extended drought in the late 80's and early 90's stressed the trees, leading to increased insect and disease activity. High levels of subalpine fir mortality can significantly change the structure and composition of the fir forests. Historically, fire regimes of mixed severity occurred on a 50 to 80 year cycle, with lethal fires every 100 to 300 years. Because of increased mortality in these older age

class forests the potential for stand replacing fires has increased. However, current conditions within the Region are within the historical range of variation for the type.

Potential major changes in stand structure and composition are high for this type. Changes will eventually occur as a result of large, stand-replacing fires, insect epidemics, or a combination of the two throughout much of the fir range.

Quaking Aspen

Quaking aspen is distributed throughout the State, occurring primarily along drainages, and at springs and seeps in mountainous terrain. The age of trees generally varies from 60 to 120 years. Most of the quaking aspen in Nevada is in a mid- to late seral stage of succession. Stands are not regenerating across much of the state for different reasons. In upper montane locations, conifers are beginning to dominate aspen stands. Without some form of disturbance to stimulate aspen suckering, and reduce shade intolerant conifers, these stands will continue to decline. In other areas wild and domestic grazing animals are preventing the stands from regenerating. Without management, these aspen clones will disappear and the probability is high that significant aspen acreage will continue on the path of succession to other vegetation types. The lack of successful regeneration over large areas increases this risk. Continued heavy browsing pressure on existing quaking aspen and other forage species will result in habitat degradation for all species found within this type.

Sierra Nevadan Forests

Sierran coniferous forests below the subalpine type can be classified as Red fir/Lodgepole pine, mixed conifer, and eastside pine. The red fir/lodgepole pine type occurs between 7000 and 8500 feet. Composition varies from almost pure fir to pure pine; with less frequent associates being white fir, Jeffrey pine at lower elevations and western white pine and mountain hemlock at the upper elevations. Fire frequencies are low in these high elevation forests and consequently, fire suppression policies have had less effect here than within the lower, drier forest types in Nevada.

The insects commonly associated with the species are fir engraver beetle, needle miners, and mountain pine beetle. Insect activity is at background levels currently. Earlier in the decade a prolonged drought combined with high stocking levels and annosus root disease led to high levels of mortality in the red fir. Lodgepole pine at high elevations was little impacted by the drought. Where associated with locally high soil moisture conditions at lower elevations, mountain pine beetle caused significant mortality. Overcrowding, the species' branch retention habit, and large numbers of beetle killed trees combine to create a significant wildfire hazard.

Mixed conifer forests are located below the red fir/ lodgepole pine type. Depending on aspect, soil moisture regime and disturbance history, the forest can range in species composition from almost pure white fir to a well balanced mix of white fir, Jeffrey and ponderosa pines with a smaller complement of sugar pine and incense cedar. The elevation range of this type is roughly 5800 to 7000. As in other forest types, fire suppression policies and the lack of active forest management has led to very high stocking levels, large fuel accumulations, and unsustainable species compositions over much of this type. Fire frequency within this type typically ranged from 5 to 30 years. Many of these areas have not experienced fire for over 100 years, putting much of the area far outside the natural range of variability for many characteristics. This situation places the forest at high risk of rapid change due to fire and insect activity.

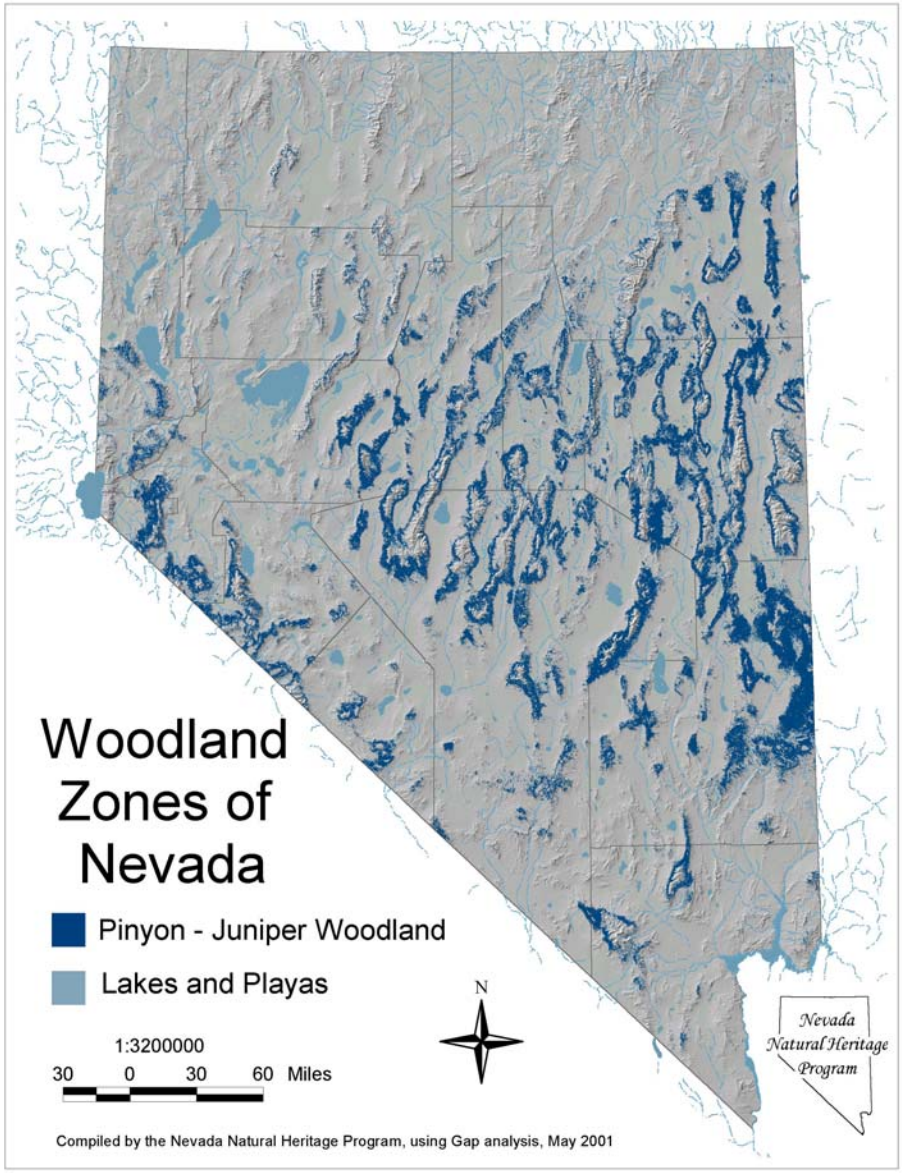
The drought of the late 1980's to the mid 1990's triggered a bark beetle epidemic in the mixed conifer type that led to the death of millions of forest trees range-wide. The standing dead trees constitute a large fuel load. Current bark beetle activity is at endemic levels. Dwarf mistletoe is the most significant pathogen in these forests. The parasitic plants exist on all conifers in the ecoregion, except for incense cedar. Where levels of infestation are high, natural regeneration of the affected individuals is not possible, leading to species composition changes in the future.

Below the mixed conifer type is the yellow pine type (e.g., Jeffrey and Ponderosa pine). Historically this type was characterized by open "park like" conditions with multiple age classes distributed as small even aged groupings. Wildfire burned on a 5 to 12 year cycle removing brush and tree regeneration, and stimulating herbaceous plant growth. Fuel accumulations were spotty and insignificant. In Nevada, the southernmost occurrence of the yellow pine forest type is in the Spring and Sheep ranges in Clark County. Past cutting practices and fire suppression have left large portions of the yellow pine forests in overstocked, even-aged conditions. Basal areas exceed 250 square feet per acre, distributed among smaller size classes. Fuel accumulations are exceedingly high for this type and wildfire hazard is high. Risk of attack by Jeffrey pine and western pine beetles, and flat-headed borers are very high under current conditions. Western dwarf mistletoe is widespread across the type and infections are intense.

Pinyon-Juniper Woodlands

The pinyon and juniper (PJ) type is the most widespread forest type in Nevada (Figure 4-4). The PJ woodland type is composed of pure stands or a mix of singleleaf pinyon pine and three species of juniper, western, Utah, and Rocky Mountain. Utah juniper is by far the most widespread of the three. PJ woodlands have been harvested for fuel wood, posts and Christmas Trees. Also called "pygmy conifers" due to their short stature at maturity, PJ woodlands are found throughout the state, occupying about 7.1 million acres (10 percent of the state). The most extensive woodland areas occur in eastern Nevada, though western and central Nevada woodland areas are also large.

Figure 4-4. Approximate Distribution of Pinyon and Juniper Woodlands



The range of the PJ woodland type has expanded and receded over the past 7,000 years, apparently the result of climate fluctuations. Over the past 500 years, the PJ populations have expanded further north, into the higher elevations, and down slope onto deep, well-

drained soils on alluvial fans. The "migration" is believed to be a response to climate change as well as human induced changes. Aggressive wildfire suppression and deteriorated rangeland habitats have presented pinyon and junipers opportunities to become established in shrub and grass communities. These factors may also be creating favorable conditions for PJ stand density to increase and create a closed pygmy conifer canopy. Figure 4-4 shows the distribution of PJ woodlands about 1990.

The rate of woodland expansion appears to have accelerated during this century. Wildfire in pre-settlement PJ woodlands is thought to have been comparatively frequent (10 to 30 year recurrence, compared to 30 to 50 year intervals for Great Basin sagebrush), burning small trees and lighter fuels and leaving more of this vegetation type open and thickets confined to rockier and more dissected terrain (Griffen, 2002). Risk of catastrophic wildfire is greater in the crowded conditions that are more commonplace in portions of eastern, central, and western Nevada. When conditions are right, stand-replacing fires can carry from the younger stands into the sparse, older stands, eliminating them as well.

Wildfire in pinyon thickets can readily crown. PJ woodland harvesting and management ideas, viewed retrospectively, were mistaken. Ecologists surmise that clear-cutting; over-grazing herbaceous plants; and, fire exclusion abetted overcrowding. Actions taken to protect woodland zone watersheds and biodiversity include controlled burns in open PJ stands, pre-treatment of fuel-dense green woodlands, and restoring those burned.

As woodland cover and density increase, other plant communities disappear. The replacement of native shrub and grass communities corresponds with a loss in diversity of land uses, native wildlife and habitat diversity, and favorable watershed conditions. For decades, ranchers, sportsmen, and agency land managers have attempted to remove and thin PJ forests using heavy equipment, herbicides, and fire in favor of shrub/grass vegetation. Likely there have been some locally important conversions; however, insufficient data exists to determine the amount of PJ forest converted and the resource advantages and disadvantages.

Insect and disease activity in the woodland type is at low levels. The most common destructive insects are pinyon ips bark beetle and borers. Population increases in these insects are usually local and are triggered by some sort of disturbance. Dwarf mistletoe is widespread in the pinyon pines and is the trees' most significant pathogen. Local pockets of Black Stain Root disease occur across the type. True mistletoe is common in the juniper species, but its harmful effects are minimal.

Currently, commercial and domestic use of woodland resources is limited to fuel wood, fence post, and Christmas tree harvesting. Opportunities exist to utilize PJ, but hauling distances and transportation costs to market are high. Promising economic ventures include combustion with other fuels at power plants to generate electricity, production of engineered chipboards, and the distillation of products from pinyon and juniper oils. As in other forest types of Nevada, the number of residential and commercial developments encroaching into woodland areas has increased. The risks and environmental impacts are the same. A major concern is the threat and management of wildfire. As an alternative to chaining, burning, or chemically treating woodlands, state and federal agencies are exploring and promoting productive uses.

Urban and Community Forests

For trees to grow in Nevada's communities, someone must plant them, then nurture and care for them for life. Nevada's earliest settlers planted the first urban forests with tree seeds and cuttings brought from their homelands and from cuttings taken from Nevada's native cottonwood trees. When the railroad was completed in the late 1860's and early 1870's, settlers began planting large, rooted trees delivered by train, alive and in good condition. Surviving trees continue to be the basis of the urban forests in older communities, providing shade, wind protection, and wildlife habitat. Unfortunately, many of these are in poor condition from improper care and pruning practices. Trees in Nevada are as important today as in

settler times. The protection and proper care of community trees is a major concern. For every tree planted in America, four die. The average life expectancy of an urban tree ranges from seven to 15 years.

The NDF administers the state's Urban and Community Forestry Program. All tree care programs in Nevada have been implemented through the U.S. Forest Service, State and Private Forestry Program, municipal, or volunteer efforts. Since 1991, almost one million dollars of Federal funding has been awarded to communities and groups in Nevada for tree planting and tree care education. The loss of federal funding for urban forestry programming would seriously impact tree planting and tree care education in Nevada and could have a long lasting detrimental affect on the health of the urban forests.

Receiving recognition from the National Arbor Day Foundation under the Tree City USA program is an indication of the ability of a community to sustain and manage its urban forests. In 1990, only three Nevada towns had received Tree City USA distinction – Boulder City, Las Vegas and Reno. The number increased to seven in 1995, but fell to six by 2000 when Las Vegas failed to re-certify in 1999. The six Tree City USA communities are Henderson, Boulder City, Reno, Sparks, Carson City, and Nellis Air Force Base. Each has a recognized person or group responsible for tree management, a street tree ordinance, an Arbor Day Proclamation and tree planting celebration, and spends $2 per capita on their tree program. Non-incorporated towns in Nevada may have good tree care programs, but are difficult to enroll in the Tree City USA program. One reason is that county and a community's budget is difficult to separate; and, the county's tree budget may not meet the minimum $2 per capita requirement consistently from year to year.

Farm and Ranch Land

Farming and ranching represents an important land use and economic activity in Nevada. Agriculture only makes up a small portion of the gross state product, but it is important to rural counties. Almost 90 percent, or approximately $315 million of the total annual market value of agricultural products sold is generated within 14 rural counties, (excluding Carson City, Clark, and Washoe counties) (Table 4-3). The economic activity generated from agricultural production represents a substantial revenue source for rural economies in Nevada. Nearly all the agricultural products in Nevada are sold for export, so the agricultural sales provide an important source of income to rural communities.

Compared to national average of about 450 acres per farm, agriculture in Nevada is characterized by a small number of large acreage, family-owned operations (Table 4-4). Of the total private farmland, 81 percent is classified as rangeland and 13 percent as cropland. Of the cropland area, 62 percent is harvested and 31 percent is pastureland. The average farm size in 1997 is about half of that in 1978. During that period, the annual output from the farming sector doubled, growing from 70 to 142 million dollars (Nevada Agricultural Statistics Service, 2000).

About 40 percent of the state's total agricultural output is from animal production (Figure 4-5) (Nevada Agricultural Statistics Service, 2000). It is the largest sector in Nevada agriculture. A recently released study

Table 4-3. Summary of Agricultural Production by County, 1999

County	Market Value of Products Sold ($ 1,000's)	% of State Total
Carson City	198	>1
Churchill	38,058	10.7
Clark	18,926	5.3
Douglas	8,796	2.5
Elko	49,228	13.9
Esmeralda	4,016	1.1
Eureka	13,133	3.7
Humboldt	57,315	16.1
Lander	12,794	3.6
Lincoln	7,317	2.1
Lyon	53,959	15.2
Mineral	1,809	0.1
Nye	27,792	7.8
Pershing	32,679	9.2
Storey	93	>1
Washoe	22,518	6.3
White Pine	8,236	2.3
State Total	356,565	100.0

Source: 1999-2000 Nevada Agricultural Statistics

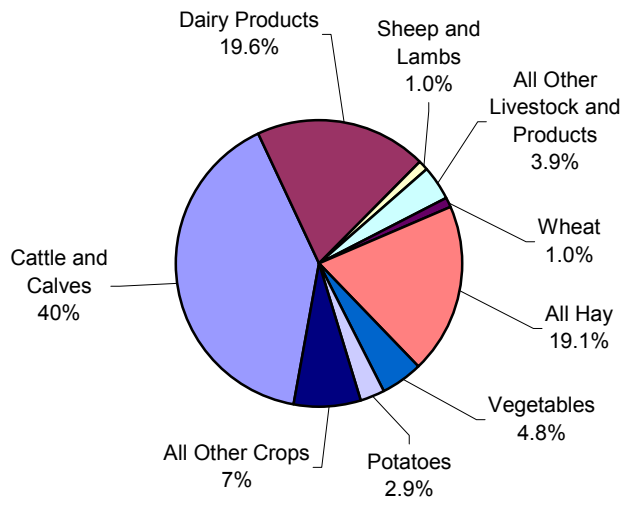
commissioned by the state Department of Agriculture documents a loss of over 475,000 animal unit months (i.e., the amount of forage consumed by a cow/calf pair or 5 ewe/lamb pairs in a 30 day period) of permitted public land grazing from 1980 through 1999. Over the 19-year period, the level of permitted grazing decreased 16 percent (Resource Concepts Inc., 2001). The reasons for reducing permitted grazing are related to resource issues and grazing permit violations. Between 1982 and 1987, the inventory of Nevada cattle decreased from about 600,000 to 500,000, but has held close to that number since. The inventory of Nevada sheep has fluctuated between 80,000 and 100,000 between 1987 and 1999. In 1999 the number of sheep was about 82,000, close to the 1987 number. Nearly 100 percent of the beef cows, sheep, and lamb raised in Nevada were produced on ranches with some dependency on federal public rangeland. Accordingly, federal policies and management have a direct economic effect on the animal production sector and rural county economies.

Table 4-4. Number and Area of Farms and Ranches in Nevada: 1974-1997

Year	Number of Farms	Total Farm Area (1,000 acres)	Average Farm Size (acres)
1974	2,076	10,814	5,209
1978	2,399	10,427	4,346
1982	2,719	9,980	3,671
1987	3,027	9,989	3,300
1992	2,890	9,264	3,205
1997	2,829	6,409	2,266

Source: 1997 Census of Agriculture Vol. 1 Geographical Area Series, Part 28, Nevada & County Data.

Figure 4-5. 1999 Cash Receipts from Nevada Farm Marketings



Of the land classified as cropland, 62 percent is cultivated for production of field and specialty crops (e.g., winter and spring wheat, barley, onions, garlic, and potatoes) and nearly 31 percent is pastureland. Approximately 75 percent of the farms in Nevada have access to irrigation, but in any given year only about 10 percent of the total farmland is irrigated (Table 4-5). Due to the arid climate and droughty soils, only a small portion of the land that is currently farmed in Nevada is considered prime crop or pastureland (Table 4-6) (Nevada Agricultural Statistics Service, 1999).

On-going trends in Nevada agriculture include increased output in horticultural products, high value row crops, and other less traditional enterprises. Traditional family farms and ranches have been facing increasing economic challenges and non-farm demand for their land and water resources. Nearly half (45 percent) of the farm operators in the state do not list farming or ranching as their principal occupation. The number of small, specialty, and equine operations is increasing. Many small part-time operators are in agriculture to preserve their way of life. They may not sell any agricultural products, or provide product solely for local or niche type markets. Almost half (48 percent) of the Nevada farms had annual sales of less than $10,000 according to the 1997 Census of Agriculture.

While certain components of the state's agricultural industry are expanding, other traditional sectors such as livestock production have stagnated or receded over the past decade. Agricultural water rights and arable land are being purchased and converted to non-farm uses to meet the demands of a growing, diversifying urban and rural population. The demand for agricultural water rights to meet additional municipal and industrial uses in urban areas will probably grow, since water resources are approaching full commitment, and approximately 77 percent of the water consumed in Nevada is for agricultural purposes. Once water rights are transferred from irrigated cropland or pastures, implementation of a site-specific revegetation plan is crucial to avoiding environmental problems, such as soil erosion, air pollution from wind-blown particulates, and nonnative plant invasions.

Table 4-5. Levels of Agricultural Irrigation in Nevada

Year	Irrigated Land (Acres)
1987	778,977
1992	556,172
1997	764,738

Source: 1997 Census of Agriculture: Nevada State & County Data. Nevada Agricultural Statistics Service, 1999

The NRCS estimates that 2,136 acres of cropland were converted to residential, commercial, industrial, or transportation uses from 1992 and 1997, an eight percent share of the total amount of land developed. From 1987 to 1997, about 16 percent of the prime crop and pasture land in Nevada was taken out of production (Table 4-6) (U.S. Natural Resources Conservation Service, 2000). Available data is not sufficiently detailed to determine in which areas of the state and for what uses prime farmland is being converted. From general observations, farmland is being converted in urban and rural areas for residential and commercial development and for wildlife habitat. In western Nevada, the loss of green space and cultural heritage associated with agriculture has heightened interest in the preservation of open space associated with farming and ranching. The purchase of development rights and conservation agreements through private and/or government sponsored agricultural trusts is a market-based approach to preserving the rural, agricultural character of Nevada that is generally viewed more favorably than regulatory alternatives, such as local zoning ordinances. Two conservation easements have been executed on ranches in Nevada for protection of sensitive species occupying wetland habitats in Ruby and Oasis valleys (eastern and southern Nevada, respectively). Availability of water has always been a controlling factor in agricultural developments, so farms lie adjacent to many of the state's limited number of rivers and streams.

Table 4-6. Changes in the Amount of Prime Farmland in Nevada, 1982 - 1997

Year	Cropland (Acres)	Pastureland (Acres)	Total Prime Farmland (Acres)	Change in Total Prime Farmland (%)
1982	286,800	22,800	309,600	---
1987	291,700	19,500	311,200	1.0
1992	264,900	15,000	279,900	-10.1
1997	246,300	15,300	261,600	-6.5

Source: 1997 National Resources Inventory, revised December 2000. Natural Resources Conservation Service.

The quality of surface water improved in past years with the removal and placement of more stringent standards on discharges of pollutants from municipal and industrial point sources. Today the focus is on nonpoint sources. Agriculture in general has the largest impact on water quality. Primary sources are runoff from irrigation, intensively grazed ranchland, and large livestock feeding operations. Nutrients, sediment, temperature, and pH are pollutants of concern (Nevada Division of Environmental Protection, 1998). Increased Clean Water Act regulations have increased agricultural production costs, and in some cases, reduced agricultural production or output. State and federal environmental protection agencies emphasize the voluntary control of nonpoint source pollution loads as a primary means for improving impaired water. All major rivers contain reaches that exceed water quality standards.

To help private property owners reduce pollution from agricultural practices, the Environmental Quality Incentive Program (EQIP) administered by the NRCS and the Clean Water Act Section 319 Grant Program provide matching funds for best management practices for water quality improvement. Nevadans continued to show interest in EQIP during 2000. Fifty-five landowners or operators applied for funding, which totaled $1,005,400, resulting in 43 contracts. The majority of the practices focus on

improving grazing land production and water quality and quantity. Practices include irrigation system improvements for conservation, fencing, stream bank protection, windbreaks, spring developments, prescribed grazing, wildlife habitat, and pest management. Eleven contracts were awarded to Native Americans or tribes amounting to $197,000, including $90,000 in Native American EQIP funds. In general, though, profitability of agricultural enterprises also is under pressure from increased production costs (e.g., energy, transportation, labor factors) without offsetting increases in product value (U.S. Natural Resources Conservation Service, 2001).

Mineral Resource Land

Nevada led the nation in production of gold and silver throughout the 1990's. Mining is especially important to rural community economies in northern Nevada where most of the large gold and silver mines are located. Production in 1999 was 8.3 million troy ounces of gold and 19.5 million troy ounces of silver, worth approximately $2.5 billion. In 2000, gold and silver production increased to 8.5 million and 23.0 million troy ounces, respectively, but the dollar value was about the same as 1999 due to lower prices for both metals. The industry employs about 11,000 people in Nevada, and pays a higher average wage than any other employment sector. Recent declines in precious metals prices have forced many companies to cut costs with layoffs or increased production. Exploration expenditures in 1999 were approximately half of the 1994 expenditures.

Other minerals are mined in Nevada. The recent increase in energy prices has increased demand for barite, which is primarily used for drilling mud. Industrial minerals such as silica sand (for making bottles and jars), diatomite (cat litter and filters), limestone/lime, lithium compounds, gypsum, magnesite, perlite and salt, and specialty clay continue to be mined at relatively stable rates. Enhancements in technologies and regulations have reduced the number and magnitude of negative environmental impacts from individual mines. State and federal agencies continue to work with industry and the interested public to ensure that mining operations from design through reclamation minimize and mitigate negative impacts and return disturbed land to a productive use. Mines are subject to extensive permitting and monitoring through their entire life cycle – during start-up, operations, reclamation, and closure.

The NDEP is the state permitting agency for all mining operations and exploration projects. For a mine or exploration project taking place on public land, a plan of operation approved by the responsible federal land management agency may be substituted for the permit application. Proposed exploration projects and mines located on public land are subject to an assessment of environmental impacts and implementation of an approved mitigation plan in accordance with the National Environmental Policy Act. The state Bureau of Mining Regulation and Reclamation within the

Reclamation of a waste pile at a modern-day mine on the Carlin trend in Eureka County. Regulations, university and industry research, and corporate stewardship have brought about improvements in reclamation planning and practices. A total of 2,375 acres (441 on private and 1,934 on public land) were reclaimed at large mines between 1996 and 2000 (Table 4-7). State law requires that large mine operators return mine sites to a productive use, such as wildlife habitat or grazing land. 1992 photo courtesy of Newmont Mining Company and NBMG.

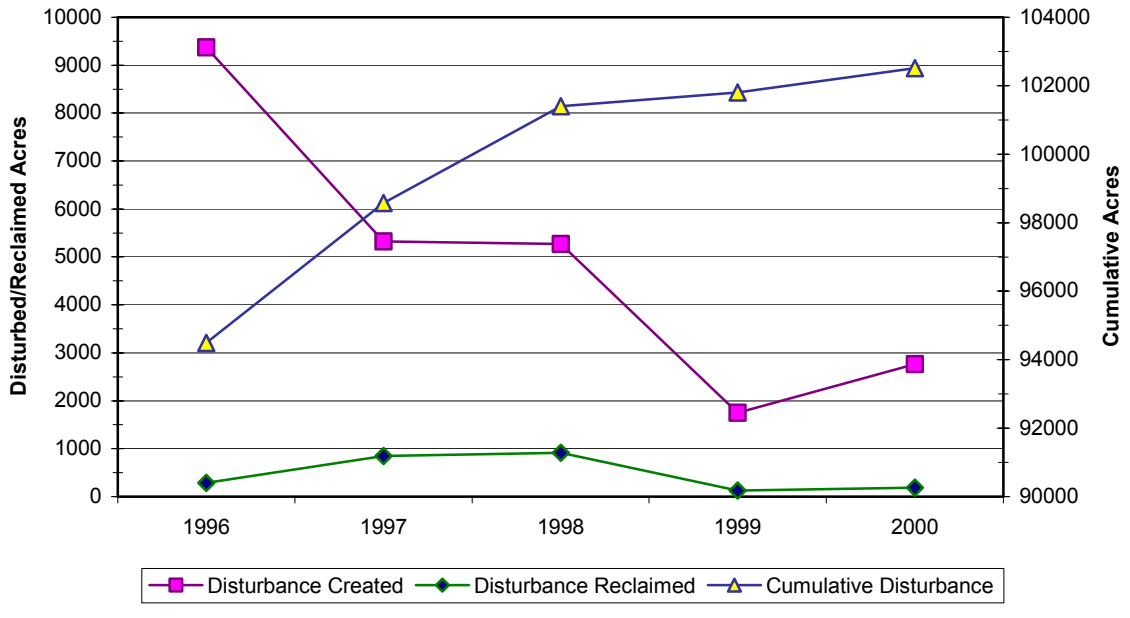
NDEP regulates 151 active mining operations through water pollution control permits to make sure the quality of water resources is not degraded. In 2000 and 2001, six percent of the regulated mining facilities were found by the Bureau to be in substantial noncompliance with permit conditions (i.e., an order or notice of violation has been issued, and enforcement activities are ongoing).

Land disturbed by mining and mineral exploration projects must be reclaimed according to federal and state law (NRS 519A). Reclamation means shaping, stabilizing, revegetating or otherwise treating the land, during or after mining and exploration activity, to return the site to a safe, stable condition that establishes a productive post-mining land use. Properly done, reclamation reduces risk of water quality problems, recreates wildlife habitat, controls slope erosion, and returns soil conditions capable of supporting native vegetative cover. Some reclamation requirements are retroactive for disturbances created after January 1, 1981.

A mining company must post a bond to ensure that funds will be available for reclamation in the event that the operator defaults. The Nevada Division of Minerals administers a bond pool that guarantees up to one million dollars of reclamation activities for small companies that have been refused help by commercial sources. Currently 253 mining reclamation operations have the required financial bonding. Ninety-eight percent of the mining reclamation operations have obtained required bonding.

Since 1989, operators of "large" mines and exploration projects (i.e., projects exceeding 5 acres of disturbance or 36,500 tons removed annually) annually report the amount of land disturbed and reclaimed to the NDEP. A project area is "reclaimed," and the bond released only after NDEP or federal agency officials have verified that the work conforms to an approved reclamation plan and guidelines. Guidelines address topsoil replacement, slope stabilization, and sustained reestablishment of plant communities representative of the project site. Between 1996 and 2000, the cumulative amount of public and private land disturbed for large mining and exploration projects increased by about 14,230 acres (Figure 4-6). Approximately 2,370 acres were reclaimed (Nevada Division of Environmental Protection, 2002).

Figure 4-6. Large Mine and Exploration Land Disturbance and Reclamation Activity, 1996 to 2000



Source: Nevada Division of Environmental Protection, 2002.

For the same period, mining companies reported a total of 18,880 additional acres were disturbed and 1,934 acres were reclaimed on public land (Table 4-7). On private land, 6,688 more acres were disturbed and 433 acres reclaimed. A majority of the additional land disturbed and reclaimed each year occurred on public land. The totals do not include incremental disturbance or reclamation occurring at mines or exploration projects that disturb 5 or less acres or that remove 36,500 tons or less each year. About 20 percent of the disturbance is reported as monitored reclamation, meaning earthwork and seeding has been completed, but the bond has not been released.

Table 4-7. Reported Large Mine and Exploration Land Disturbance and Reclamation Activity, 1996 to 2000.

Year	Private Land			Public Land			Cumulative Disturbed Public and Private Land Acres
	Additional Disturbed Acres	Additional Reclaimed Acres	Cumulative Disturbed Acres	Additional Disturbed Acres	Additional Reclaimed Acres	Cumulative Disturbed Acres	
1996	2,528	5	45,373	6,843	285	49,114	94,487
1997	1,803	124	47,844	3,520	728	50,734	98,577
1998	1,591	245	49,083	3,682	670	52,319	101,403
1999	613	28	49,588	1,137	102	52,210	101,798
2000	958	39	51,123	1,805	149	51,392	102,514
Total	7,494	441	---	16,987	1,934	---	---

Source: Nevada Division of Environmental Protection, Bureau of Mining Regulation and Reclamation, Annual Reclamation Report database.
Notes: Values only include disturbed or reclaimed acres at mines that annually disturb more than 5 acres, or remove more than 36,500 tons. Cumulative totals are based on reported data and do not precisely account for the annual net change in acres disturbed and reclaimed. Reclaimed area values reflect approved final reclamation and do not include areas that are partially reclaimed from completed earthwork and/or seeding.

Sometimes the nature of the ore deposit requires massive excavations called open pit mines. Open pit mines that extend below the groundwater table must be de-watered to keep from flooding the operating area. In many mines, the amount of water that must be pumped exceeds the mines' consumptive use needs. Excess water from open pit operations are used beneficially in a variety of ways. A majority of the excess water is discharged to surface water systems, re-injected into aquifers, or applied to crop land, or piped to power plants. After the mining and de-watering stops, the pits will eventually fill. Open pits may be exempt from reclamation, subject to NDEP approval.

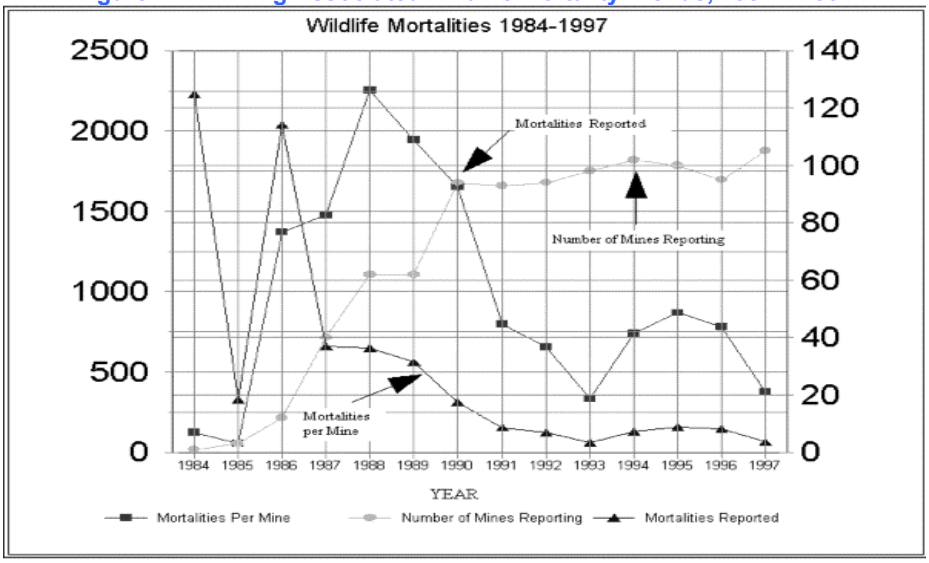
Over the long term, there is uncertainty over the potential cumulative and regional impacts dewatering of open pit mines will have on surface and groundwater resources. Other water users in the region and the public have expressed a deep concern, prompting government agencies and the industry to study the potential long-term impacts of de-watering on the hydrology of the region and water quality of the pit lakes. Most large open pit mining operations with dewatering discharges are located in the Humboldt River Basin. Mining water withdrawals initially were anticipated to remain relatively constant at about 275,000 acre-feet per year with a slight increase up to the year 2010. However, changes in mining operations are difficult to predict. More recent indications are that pumpage will decline at some major mines.

The trend of pit dewatering activities generating water volumes in excess of mine processing and consumptive needs is expected to continue. Actual mine dewatering may change if operators shift from open pit mining to underground mining, or if economics change. However, some degree of mine dewatering is expected to continue regardless of the type of production activity. Precious metal production from underground mines is slowly increasing. In 1999, about 24 percent of Nevada's gold production came from underground mines. In general, underground mines are easier to permit than surface mines because less land is disturbed.

Mining Operations and Wildlife

The mining industry and the NDOW have coordinated efforts to reduce direct mortality of wildlife at mine sites, particularly losses resulting from cyanide or other types of chemical poisoning. Since 1990, the NDOW and mine operators have worked together to implement a regulatory program to prevent wildlife mortality at heap leach ponds and mine tailings. Efforts to study and reduce wildlife mortality began in 1984, when use of the heap leach mine technology surged in Nevada.

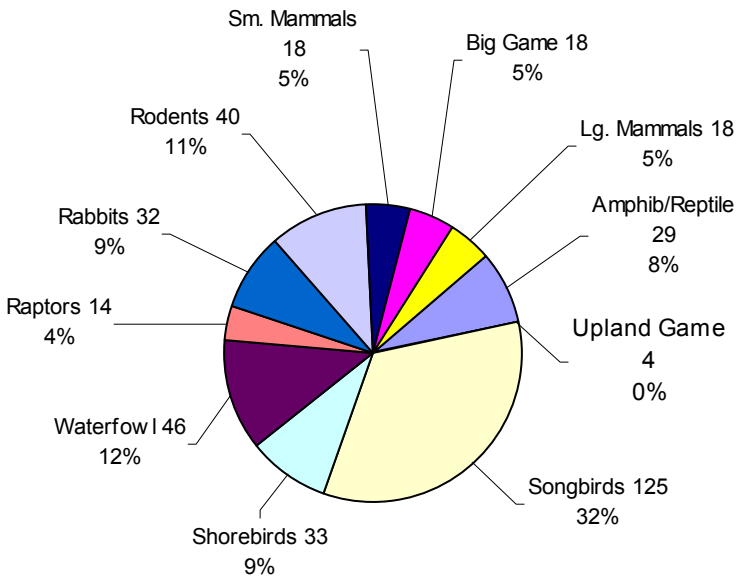
Figure 4-7. Mining Associated Wildlife Mortality Trends, 1984 – 1997



Source: NDOW, *Mining and Wildlife*, Vol. VII, No. 4. July 1998.

As a result of the joint efforts and the Industrial Artificial Pond permit program, overall wildlife mortalities at mine sites decreased from over 2,000 individuals in 1986 to just over 300 in 1997 (Figure 4-7). Less than 50 percent of the 1997 mortalities were the result of contact with permitted cyanide ponds or protective measures. These measures include fencing, pond covers (e.g., netting), HDPE floating "bird-balls", floating pond covers, dilution, and chemical neutralization. Figure 4-7 summarizes the overall decrease in mining related mortalities in Nevada since 1984. The average number of mortalities per mine decreased from over 100 individuals per mine to less than 10 individuals. A low of 3 individuals per mine occurred in both 1993 and 1997. During the 1990's, the number of permitted

Figure 4-8. Mining-Associated Wildlife Mortality by Animal Group, 1997



Source. *Mining and Wildlife*, Vol. VII, No. 4. July 1998. NDOW.

facilities at mines hovered around 100. About half of the increased number of mortalities from 1994 through 1996 was attributed to rodent (primarily mice) mortalities.

Waterfowl, shorebirds and big game animal deaths continued to decline during these years. The decrease in the total number of mortalities, from 1,645 in 1990 to 377 in 1997, includes a four-fold decrease in the numbers of bird mortalities during that period. Waterfowl mortalities reached an all time low of 16 individuals in 1995. Data on the distribution of mortalities by major animal groups in 1997 is presented in Figure 4-8. The program goal of zero mortality appears to be attainable. Twenty-nine active mines accomplished this goal in 1997. An additional 33 permit holders reported 5 or less wildlife mortalities over the entire year (Nevada Division of Wildlife, 1998).

Abandoned Mine Land Safety

The estimated number of potentially hazardous abandoned mine openings in Nevada is at least 50,000 (Nevada Division of Minerals, 2000). NDOM has identified 8,118. About 6,000 have been secured by NDOM, claimants, owners, or volunteers. Fencing is the most common security measure. About 1,000 have been backfilled. A priority is backfilling dangerous mines located near urban areas. The NDOM and the BLM have agreements in place to streamline the securing process. The number of new sites secured each year is expected to remain in the range of 300 to 400. Backfilling requires that properly trained scientists do biological and cultural surveys.

Backfilling may not be suitable in some instances. Mines can represent essential habitat for sensitive wildlife, especially bats. Today, the Nevada Bat Working Group is providing biological input to closure plans for the remaining mine openings. Three of Nevada's most significant bat roosts on record occupy historical mine workings. These unique resources include: the largest known big-eared bat (*Corynorhinus townsendii*) hibernation roost in Nevada (White Pine County); the largest known small-footed Myotis bat (*Myotis ciliolabrum*) hibernation roost in Nevada (Eureka County), and 3) Nevada's largest known pallid bat (*Antrozous pallidus*) maternity roost (Pershing County). There is considerable concern about bat roosts in mines that are, as yet, undiscovered (Bradley, 2002). Though some private and public entities continue to use total closure techniques, effective alternative mine closure methods have been designed, such as wildlife-friendly gates, to meet both safety and biological objectives.

Abandoned Mines and Water Quality

Today, mining operations are subject to water pollution control permits that ensure the mine site in the production, closure, and post-closure periods will not degrade water quality. Water quality impacts may arise if the natural metallic compounds exposed in the mine wall or removed and stockpiled rock changes chemically and leaches into groundwater or drains to a stream. Drainage of chemical solutions from ore wastes, such as cyanide solutions, may also become a water quality concern. Inadequate precautions were taken in the past, so some abandoned mines now pose minor to significant environmental risks. Such abandoned mine sites are scattered throughout the state. In the worst cases, drinking water supplies may become unusable, or fish and aquatic insects and plants may be unable to survive.

In 1999 the Interagency Abandoned Mine Land Environmental Task Force, composed of state and federal agencies, completed a statewide study to identify abandoned mine sites that pose significant environmental threats. The Nevada Abandoned Mine Lands Report identifies and prioritizes sites based on their potential to degrade water quality and jeopardize public health and aquatic ecosystems. As a result of the extensive mining history in Nevada, at least a couple thousand abandoned mine sites exist with the potential to impact ground or surface water. Because of the enormity of the effort that would be required to evaluate so many sites, the Task Force used institutional knowledge, available data and best professional judgment to identify 33 sites that may impact ground or surface water. Six of the sites have been prioritized for reclamation. Insufficient funding is anticipated to be an obstacle to achieving remediation objectives (Nevada Interagency Abandoned Mine Land Environmental Task Force, 1999).

Urban, Suburban, and Rural Developed Land

The first settlements in Nevada were established in the Carson River Basin (Genoa and Dayton) about 1855 (Rocha, 2002). Over the next few decades small, permanent towns took root, primarily wherever water supplies were sufficiently abundant and reliable to maintain ranching, farming, and mining enterprises. Rural communities dominated the state for the next century. The size of Nevada's towns remained small, in part because the high desert's limited renewable resource base (e.g., water, arable land, livestock forage, wildlife and habitat) proved to be variable and depletable. Almost 140 years passed after the first settlement was founded before the state's population surpassed the one million mark. In the 1960's, Truckee Meadows (Reno and Sparks) and Las Vegas Valley emerged as rapidly growing urban population centers. Only 25 years later, 80 percent of the population lived in a few cities located in extreme southern and western Nevada valleys. Only 15 years after Nevada reached the million-population mark, the state added another million. Today, 86 percent of the population lives in metro-areas of Clark and Washoe counties. The urbanization trend is projected to continue.

Table 4-8. Acreage and Percentage of Non-Federal Land Developed in Nevada

Year	Non-Federal Land Developed	% Non-Federal Land Developed
	Acres	%
1982	272,200	2.6
1987	320,300	3.0
1992	354,700	3.4
1997	381,400	3.6

Source: modified from 1997 National Resources Inventory, revised December 2000. Natural Resources Conservation Service. website http://www.nhq.nrcs.usda.gov/land/

Information on statewide land development status and trends is limited. The Natural Resources Conservation Service (NRCS) uses satellite images and aerial photos to periodically estimate land use changes on nonfederal land. The spatial analyses show that a total of 381,400 acres (3.6 percent) of the nonfederal land in the state (97 percent of nonfederal land is private) has been converted to developed land. Developed lands encompass urban, built-up rural areas, and rural transportation land, including residential, industrial, commercial, government, parks and schools, highways and roads. From 1987 through 1997, the NRCS mapping analysis showed 61,000 additional acres of land was developed (Table 4-8) (Natural Resources Conservation Service, 2000). During this period, the population increased by about 745,000. Compared to the population increase, the amount of additional land developed appears to be disproportionately small. This may reflect local government implementation of an "in-fill" strategy (i.e., efficient use of vacant land or redevelopment within an urban area), high-density zoning requirements, or a combination of these land use-planning strategies. Much more comprehensive information about local land development would be needed to more accurately track changes in statewide land use and the inventory of developable private land.

The NRCS data indicates that most of the nonfederal land developed for residential, commercial and industrial purposes replaced agricultural land uses. Of the 26,700 acres developed between 1992 and 1997, the NRCS estimates that 78 percent was rangeland, 15 percent pasture, and 8 percent cropland (Natural Resources Conservation Service, 2000). New development frequently involves agricultural lands, largely because farming or ranching homesteads and enterprises initially occupied private land in valleys with mild slopes, favorable climate conditions, and dependable, high quality water supplies. Though several mining towns have survived boom and bust cycles, generally these sites are not suitable for large urban and suburban development. Development on timberland is comparatively small. The NDF, which tracks timberland conversions, estimates about 3,500 acres have been converted in the past twenty years (Nevada Division of Forestry, 2001). However, urban development in forests has disproportionately large impacts to the resource due to the limited distribution of forests and to their importance in maintaining healthy urban watersheds.

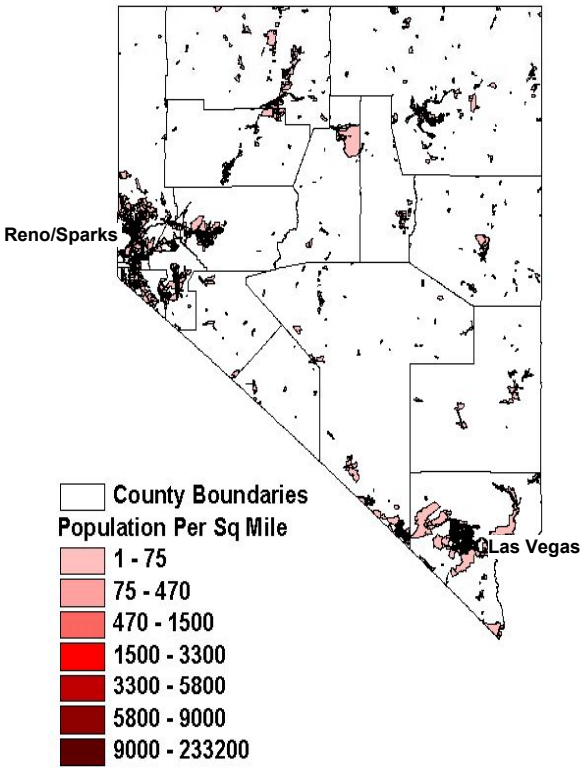
In addition to being the fastest growing state, Nevada has the driest climate, the most mountains, and the largest percentage of federal public lands. These unique characteristics factor into Nevada becoming a very urbanized. Only 12 percent of the land in Nevada is privately owned, most centered along the limited perennial water bodies. Most private ownership was established early in the state's history, as a

result of late 19th century acts of Congress to encourage settlement of the West through federal public land grant programs. Not surprisingly, the lands brought into private ownership contained high resource value lands, which provided reliable, clean water supplies; flat, arable soils; abundant timber; and mineral resource. As a result, a large portion of the limited developable private land consists of valuable water, agricultural, and other natural resources; or possesses characteristics adverse to development, such as rugged terrain, steep slopes, floodplains, or wetlands. In areas of the state where developable private land is limited and rapid growth is occurring, local governments are required to make difficult tradeoff decisions between building on or adjacent to valuable resource lands or allowing dispersed development patterns. Some success in resolving the developable private land dilemma has been achieved through joint land use and resource planning involving local and federal government, developers, and a variety of community interests. The cooperative approach has produced federal laws, administrative mechanisms, and local public/private land plans that enable sales or transfers of environmentally sensitive private land into public ownership in combination with the acquisition or exchange of public lands that do not possess high resource values. Most of the land sales and exchanges are occurring in urbanizing valleys of southern and western Nevada.

Urban development is transforming Nevada in many positive ways, but some changes have proved be detrimental. Figure 4-9 illustrates how widely distributed urban and rural population centers remain despite a doubling of the state's population in 15 years. Notwithstanding the appearance of abundant open space between urban and rural population centers, the exuberant pace of urban development has raised region-wide resource issues that are relatively new to Nevada. One is the appearance of urban sprawl, which contributes to disproportionately large impacts on environmental quality. Table 4.9 presents calculated population densities for selected cities in Nevada and in neighboring states. Population density is sometimes cited as one measure of sprawl.

Sprawl is generally viewed as inefficient resource consumption and ineffective land management. A sprawling development pattern extends road and utility corridor construction and expands disturbance in native plant communities, thereby enlarging the area of soil disturbance and erosion, water quality impairment, and noxious weed invasions. Subdivisions built outside urban boundaries often resort to using individual septic systems. Groundwater quality deterioration occurring in several valleys throughout the state is associated with high densities of septic systems. Regional air quality deterioration in part is due to greater amounts of pollution emitted from the additional vehicle miles traveled and traffic congestion that accompanies sprawl. Mobile source emissions contribute to non-attainment of carbon monoxide and particulate air quality standards in Washoe and Clark County. In both urban and rural counties, subdivisions built in "wildland" areas have become an issue for wildfire management agencies. Homes built in flammable and fuel-rich areas are exposed to greater risk of wildfire damage. When

Figure 4-9. Nevada Population Distribution in 2000



Source: State of Nevada, Office of the Demographer. 2000.
Note: Population distributed by census block. Though color gradations are not distinguishable, the graphic clearly illustrates both the rural character and urban population centers of the state.

wildfires occur in such areas, fire-fighting resources intended for protection of natural resources must be diverted to protection of structures, resulting in greater resource damage.

Table 4-9. Population Density of Cities in Nevada and Selected Cities in Neighboring States

City	Population in 2000	Land Area (square mile)	Density (population per square mile)
Las Vegas	478,000	113.3	4,223
Reno	180,000	69.1	2,611
Henderson	175,000	79.7	2,201
North Las Vegas	115,000	78.5	1,471
Sparks	66,420	24.0	2.767
Boise	186,000	63.8	2,913
Tucson	487,000	194.7	2,500
Salt Lake City	182,000	109.1	1,666
Spokane	196,000	57.8	3,387
Portland	529,000	134.3	3,939
San Francisco	777,000	46.7	16,634
Los Angeles	3,695,000	469.1	7,877

Source: U.S. Census Bureau, Statistical Abstract of the United States: 2001.
Note: The land area of each city includes the area bounded by incorporated city limits as reported at the time of the 2000 census.

In response to rapid growth and sprawling development patterns, local interest in the conservation of open space emerged during the 1990's. Open space resources of concern do not only occur at the urban/wildland interface. In western and southern Nevada, communities are trying to protect natural stream courses, floodplains, wetlands, access to outdoor recreation resources, sensitive species habitats, agricultural greenbelts, cultural sites, scenic views, and wildfire prone forest and shrub lands. Spurred by community leaders, citizen groups, and conservation organizations, local government in Washoe and in Carson City County established an open space advisory board, hired an open space planner, and prepared open space conservation plans. In addition, the citizens of the two counties elected to employ bond and tax initiatives as a means for open space acquisitions.

Progress has been made in joint open space planning between local government and federal agencies in urbanizing regions. Notably, the BLM and USFS have coordinated with Washoe, Carson City, and Douglas County planning departments to update public land use plans at the urban/wildland interface. As a result, the BLM amended land use plans in Washoe and Carson City counties to meet mutually beneficial objectives. Various land use plan objectives are to: retain and manage certain areas for open space values; identify land for disposal (i.e. sale into private ownership or for nonfederal use under the Recreation and Public Purposes Act); withdraw designated areas from settlement or mineral entry where land use conflicts would arise; retain existing or acquire additional public recreation access to public lands; guide future utility corridor and facility siting; designate areas closed or open to off highway vehicle use; and, identify potential Areas of Critical Environmental Concern.

Another joint federal-local program was established with passage of the Southern Nevada Public Land Management Act. Among other things, the Act directs the BLM to collaborate with local government and others in a process for selling designated public lands in Las Vegas Valley consistent with an orderly urban growth pattern. A portion of the proceeds of public land auctions fund projects in southern Nevada that enhance outdoor recreation opportunities and contribute to development of a Multi-species Habitat Conservation Plan. Revenues also are used to acquire environmentally sensitive land throughout Nevada. As of May 2001, 116 parcels constituting 2,410 acres of BLM administered land was purchased at auction, generating $106.4 million. On the acquisition side of the program, 560 acres were purchased associated with the Desert National Wildlife Refuge (i.e., Moapa Valley National Wildlife Refuge, and Ash Meadows) (U.S. Bureau of Land Management, 2001).

Military Land

Nevada hosts several major military bases, air-to-ground bombing ranges, and weapons testing facilities. The U.S. Department of Defense administers activities on military lands that occupy more than 3.1 million acres in Nevada (4.7 percent of state land area). Use and management of natural resources on an area

this large has significance for the resources found on military lands themselves, as well as those of surrounding areas.

In southern Nevada, public land has been withdrawn from public entry and allocated to the United States Air Force to support the Nellis Air Force Base (NAFB) and Nellis Test and Training Range (NTTR). The Nellis Range is used for air-to-air and air-to-ground combat training by US composite strike forces and NATO forces. Every type of combat and combat support aircraft in the Air Force inventory is deployed over the Nellis range. Military special use airspace and ground targets are maintained to support air-to-air combat, air-to-ground bombing, and electronic warfare training. Overall, the NAFB and NTTR is considered the premiere air combat training center in the continental US.

Adjacent to the Nellis Range is the Nevada Test Site (NTS). Occupying just over 800,000 acres, the NTS is operated by the U.S. Department of Energy (DOE) as a nuclear weapons testing site. Although a moratorium on nuclear testing has been in place since September 1992, NTS is still maintained in "test readiness mode." Adjacent to the NTS is Yucca Mountain, which is the only site in the country being studied as a proposed High-Level Waste (HLW) repository for spent reactor fuel and defense HLW. The Nellis Range, the NTS and Yucca Mountain are located northwest of Las Vegas.

In north central Nevada, the U.S. Army operates the Hawthorne Army Depot (HWAD). It is the largest munitions depot in the western hemisphere. The depot was established in the early 1930s after the Lake Denmark, New Jersey explosion that injured hundreds in nearby towns. The HWAD occupies 147,000 acres of withdrawn public land, has over 170 support buildings along with 2,400 igloos (i.e., earthen storage magazines). The depot is located next to Walker Lake and the town of Hawthorne.

The U.S. Navy maintains an air station and training range complex in north central Nevada. The Fallon Naval Air Station (NAS Fallon) supports the famed "Top Gun" training school as well as integrated Carrier Air Wing strike training. Air-to-air combat and air-to-ground bombing is conducted in the Fallon Range Training Complex (FRTC), which occupies just over 200,000 acres of withdrawn public land. NAS Fallon is located adjacent to the city of Fallon, about 60 miles east of Reno/Sparks urban area.

Wilderness

Almost 1.7 million acres of Nevada's most ruggedly scenic areas have been designated wilderness (2.2 percent of the state). Except for the a portion of the Death Valley Wilderness Area, all of the state's wilderness areas are managed by BLM or the USFS. Designated wilderness areas are listed on Table 4-10, and their distribution is shown in Figure 4-10. Nevada's first wilderness, the Jarbidge Wilderness, was created under the Wilderness Act of 1964. The Nevada Wilderness Protection Act of 1989 greatly expanded the state's designated wilderness, adding approximately 733,400 acres. Designated wilderness in the state was almost doubled with the passage of the Black Rock Desert – High Rock Canyon Emigrant Trails National Conservation Area (NCA) Act of 2000. The NCA Act designated almost 757,000 acres within ten new wilderness area units. BLM plans to complete a management plan for the NCA and the associated wilderness areas (the Black Rock Desert, High Rock Canyon, East

Mount Moriah is a wilderness area designated within the Humboldt National Forest, located in eastern Nevada. Mount Moriah lies just north of Great Basin National Park. Wilderness areas contain many outstanding features, including in this case 12,050 feet high Mount Moriah, t\he Table, a plateau covered by subalpine Bristlecone and limber pine; four perennial streams with Bonneville cutthroat trout; Bighorn sheep; and numerous caves showing evidence of prehistoric habitation. Photo courtesy of National Wilderness Preservation System. Internet address: http://www.wilderness.net/nwps/

Fork High Rock Canyon, High Rock Lake and Little High Rock Canyon wilderness areas).

A large number of areas are being considered for future wilderness designation. Only Congress can designate the WSA's as wilderness or release them from the special designation. Many are designated as BLM or USFS "Wilderness Study Areas" (WSA's). BLM-managed WSA's total 4.4 million acres. A total of 1,590,000 acres that comprise of pieces or all of 46 WSA's were recommended as "suitable" for wilderness designation by the BLM. The remaining 2.8 million acres were recommended as "not suitable." The USFS manages 6 WSA's totaling 189,372 acres. Federal agencies are required by law to manage WSA's in a manner that protects their wilderness qualities.

The Wilderness Act of 1964 defines wilderness as "an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation." Other characteristics include: 1) natural in character…the imprint of man's work substantially unnoticeable; 2) outstanding opportunities for solitude or primitive and unconfined recreation; 3) at least 5,000 acres or sufficiently large to make preservation practicable; and, 4) contains other values important to society, such as ecological, geological, or other features of scientific, educational, scenic, or historical value.

Table 4-10. Nevada Designated Wilderness Areas

Wilderness Area Name	Agency	Area (Acres)
Alta Toquima	USFS	35,500
Arc Dome	USFS	120,597
Black Rock Desert	BLM	313,622
Boundary Peak	USFS	10,000
Calico Mountains	BLM	65,344
Currant Mountain	USFS	36,534
Death Valley	NPS	125,000
East Fork High Rock Canyon	BLM	52,754
East Humboldt	USFS	36,686
Grant Range	USFS	52,468
High Rock Canyon	BLM	46,560
High Rock Lake	BLM	59,250
Jarbidge	USFS	110,765
Little High Rock Canyon	BLM	48,688
Mount Charleston	USFS	43,918
Mount Moriah	USFS/BLM	71,370
Mount Rose	USFS	31,353
North Black Rock Range	BLM	30,764
North Jackson Mountains	BLM	23,915
Pahute Peak	BLM	57,350
Quinn Canyon	USFS	26,237
Ruby Mountains	USFS	93,112
Santa Rosa-Paradise Peak	USFS	32,053
South Jackson Mountains	BLM	56,753
Table Mountain	USFS	92,417
State Total		1,675,665

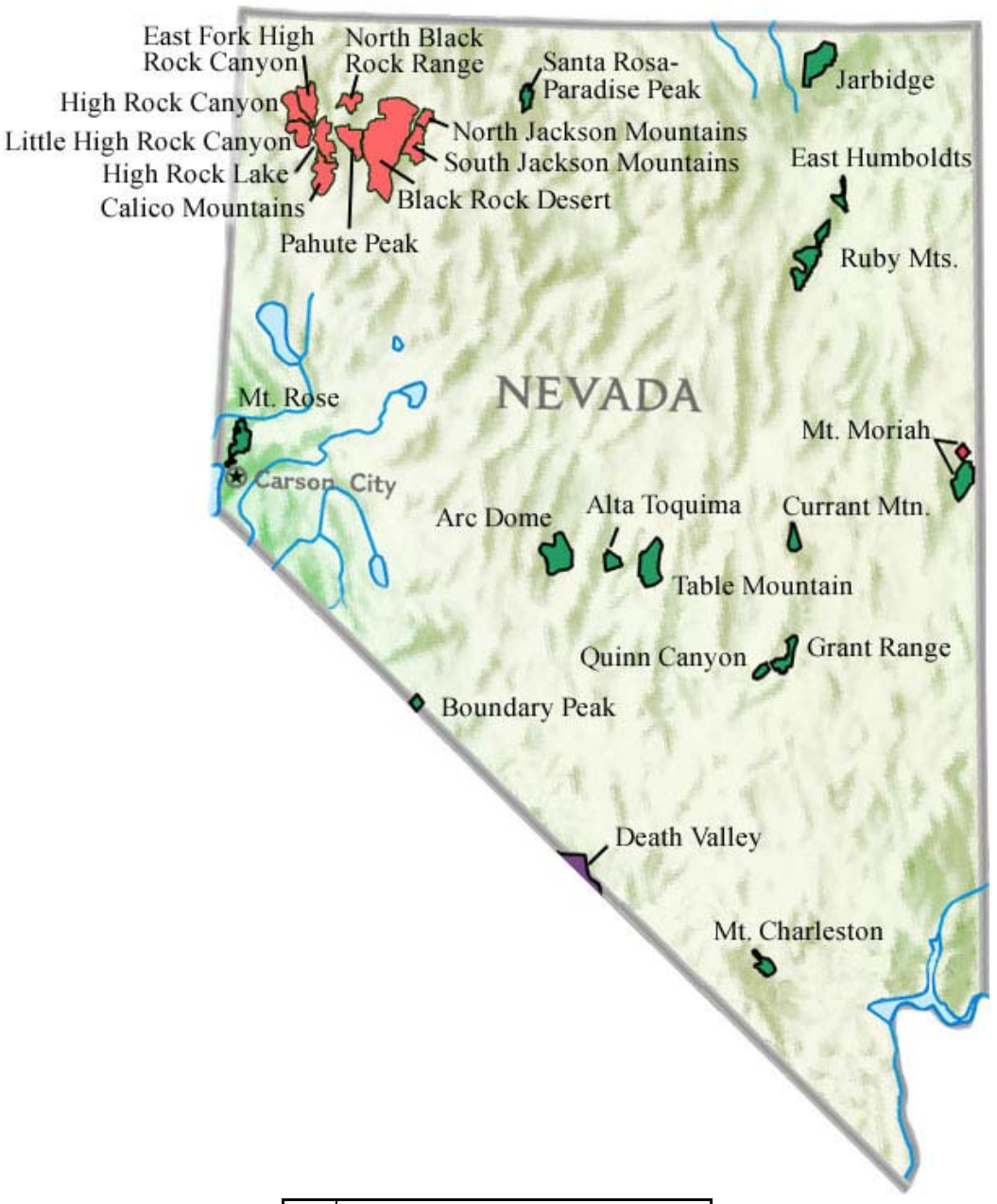
Source: Humboldt-Toiyabe National Forest and Nevada BLM, 2001.

With few exceptions, the lands that meet wilderness criteria in Nevada are predominantly steep, rugged, high altitude, or arid landscapes, and distant from towns and cities. A very limited range of Nevada's distinctive ecosystems and landscapes are encompassed within wilderness areas. Creation of a wilderness area does not eliminate existing uses, vested rights, or valid permits. Long standing grazing, mining, fishing, hunting, certain water supply developments, and recreational uses are generally allowed. However, revised rules or permit conditions may be imposed to make sure uses are conducted in ways that are more compatible with the purposes of the wilderness area specified in the Congressional act.

The Nevada Wilderness Project and affiliated organizations, including Friends of Nevada Wilderness and the Sierra Club, are expected to propose new wilderness areas for the state after they complete their ongoing statewide inventory of potential wilderness areas. Starting in 2003, the USFS will consider these proposals when they conduct a wilderness review as part of the process to update the Humboldt-Toiyabe National Forest Management Plan. This wilderness review also will consider converting some or all of the state's 3.1 million acres of designated roadless areas to wilderness. National forest wilderness areas in

Nevada are popular. In 1996, residents and visitors spent 331,800 visitor days at the 13 wilderness areas managed by the USFS (HTNF, 2000). Eleven of the wilderness areas are located in rural areas. However, data is not available on the economic benefits to rural communities that could be attributed to outdoor recreation tourism.

Figure 4-10. Distribution of the Twenty-five Wilderness Areas in Nevada



Source: National Wilderness Preservation System. Internet address: http://www.wilderness.net/nwps/

The process for designating wilderness can be contentious. In 1992, the BLM completed their studies and alternative evaluation process that led to their current recommendations regarding which WSA's are suitable for wilderness status. In 2001, the interest level in resolving the status of the WSA's grew, but a cohesive statewide planning effort remains elusive. Supporters of additional wilderness areas point out that wilderness helps protect watersheds, scenic viewsheds, rare plant and animal habitat, unique recreation experiences, and other natural resources and values.

The public demand for wilderness designations and experiences generally correspond with increasing urban populations. Rapid growth in Nevada and neighboring states is a motivating factor to wilderness proponents. Opponents feel that too many limitations on land and resource use come with wilderness designations. Potential restrictions may be placed on the future development of commodity resources (e.g., minerals, energy resources, livestock) and on use of motorized or mechanical equipment.

Some residents view designation of wilderness areas as an economically, socially, and ecologically beneficial. Wilderness areas can provide new opportunities to increase local taxes and income derived from increased tourism trade, more outdoor recreation visitors. Also, future costs associated with environmental impacts of potentially damaging land uses may be avoided. On the other hand, rural economies rely on supplementing the harvest or extraction of commodity resources from private land with resources on public land. Rural communities can experience negative impacts where wilderness area designations restrict access to economically viable mineral, energy, forage, or other commodity resources. To estimate economic tradeoffs, studies can be done that analyze the future benefits of increased recreation and tourism activity compared to resource development. However, the analysis is often complicated by disparate views in valuing environmental quality and ecological functions. Another complication arises with the quantification of assumptions used to evaluate the future costs and benefits of resource development as compared to those with tourism and recreation. Frequently the economic analysis is viewed as conjectural and controversial by one group or another, and may not contribute to objective decision-making.

Regardless, the delay in resolving the status of BLM WSA's and potential USFS wilderness areas postpones the realization of potential social and economic benefits the come with use of public land. Until Congress determines which WSA's will be designated as wilderness areas, the WSA's by law must be managed as designated wilderness. WSA's lack the broad public appeal and federal and state investment in enhanced local amenities that are given to designated wilderness areas. Perhaps soon, as citizens, government, and industry gains more experience in collaborative planning and achieving consensus on the conservation and management of natural resources, Nevadans will be better prepared to cooperatively resolve wilderness issues.

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